A P P E N D I X D

TECHNOLOGY ASSESSMENT FOR RULE 1136 – WOOD PRODUCTS COATINGS

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Technology Assessment for Rule 1136 – Wood Products Coatings

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Deputy Executive Officer
Planning, Rule Development, and Area Sources
Elaine Chang, DrPH

Assistant Deputy Executive Officer
Planning, Rule Development, and Area Sources
Laki Tisopulos, Ph.D., P.E.

Planning and Rules Manager
VOC Rule Development
Larry Bowen, P.E.

Author: William G. Milner - Air Quality Specialist

Reviewed By: Edward M. Muehlbacher, P.E. - Program Supervisor
Frances Keeler – Senior Deputy District Counsel

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EXECUTIVE SUMMARY

Rule 1136 – Wood Products Coatings was amended on June 14, 1996 and set mid range VOC content restrictions, effective July 1, 1997, primarily between 420 and 550 grams VOC per liter for most coating types. These include clear and pigmented topcoats, clear sanding sealers and pigmented primers/undercoats, high and low solids stains, wood fillers and several extremely low use products such as barrier coats, inks, mold-seal coatings, multi-colored coatings, and extreme-performance coatings. Included in the 1996 amendment is a provision for industry to submit progress reports to the AQMD by January 1, 2003, and for the AQMD to conduct a technology assessment by July 1, 2003.

Both the technical assessment and the industrial progress reports are complete and the results of both are contained in this document. Technology exists and is in use today in the form of many resin and solvent systems to meet the July 1, 2005 future VOC limits that are primarily 275 grams VOC per liter, less water and less exempt solvent. Industry has had nearly seven years to convert from high-VOC wood coatings to low-VOC wood coatings; however, approximately 16% have made the change in full. Approximately 32% are partially compliant with the future VOC limits by using at least one form of low-VOC technology. However, approximately 52% have not switched to low-VOC technology despite its availability.

BACKGROUND

On June 14, 1996, the Governing Board of the South Coast Air Quality Management District (AQMD) adopted flexible volatile organic compound (VOC) limits for coatings used on wood products. This action resulted in postponing approximately 9 tons of VOC emission reductions per day, through July 1, 2005. Today, wood finishers have options within the most widely used coating categories of sealers, primers, undercoats, and topcoats. They may either comply with a straight VOC limit of 550 grams of VOC per liter of coating across the board, or, alternatively use a “hybrid” approach that combines the application of still higher VOC sealers, primers, and undercoats with low-VOC clear and pigmented topcoats. In the case of coatings for use on shutters, the reverse hybrid approach is true (low-VOC sealers, primers and undercoats combined with high-VOC topcoats). In either case, the emissions resulting from the use of hybrid coating systems compared to the straight 550 grams VOC per liter approach are equivalent on a solids basis. The rule also affords coating manufacturers flexibility by regulating VOC content on either a per volume basis (grams per liter or pounds per gallon), or on a per weight solids basis (pound VOC per pound of solids).

According to Rule 1136 subdivision (j), all wood finishers are required to submit progress reports to AQMD by January 1, 2003, that details the extent of compliance with the future low-VOC limits of July 1, 2005. The report may either state that compliance with the 2005 limits is already achieved, or it must list the current process, wood species, and the types of coatings used to date, as well as include any test results of low-VOC products tried and further outline the plan by which future compliance will take place. As a reminder to all known wood finishers, staff notified all known facilities by mail of progress report submittal requirements, and included a form for easy reference and fill-in. Staff conducted two such mail outs, one on November 22, 2002, and a second notification on March 20, 2003.

Data obtained from the completed progress reports shows the state of wood coatings usage inside the AQMD, and that information is presented in this technology assessment. In addition, staff has researched and witnessed the application of existing low-VOC wood coatings technologies in an effort to determine its applicability and feasibility of use across the spectrum of wood products coating operations. As a result, this report satisfies the audit and technology review requirements of Rule 1136, subdivision (k). Although there are coatings that could provide additional VOC reductions, further limitations on VOC content would reduce the number of compliant technologies available and in use for nearly all applications. The expressed future VOC limits provided by Rule 1136 are established low enough to provide for a broad range of resin systems and cure types that will afford the industry sufficient choice in waterborne, exempt solvent borne, and high-solids coatings while dramatically reducing smog forming compounds. This report details the state of low-VOC-emitting technologies and provides the results of submitted progress reports.

INDUSTRIES SUBJECT TO RULE 1136

There are several industries that use coatings on wood products. In general, they can be grouped as industries that are contained within the following business types. This involves new finishing, refinishing or repair coating to a wide variety of wooden products as follows:

- ✓ Household Furniture;
- ✓ Office and Contract Furniture;
- ✓ Kitchen and Bathroom Cabinets;
- ✓ Architectural Millwork and Store Fixtures;
- ✓ Shutters, Blinds, Doors, Windows and Moldings;
- ✓ Specialty Products (Musical Instruments, Toys, Speaker Cabinets, Picture Frames, Skateboards, etc.);
- ✓ Repair and Refinishing Operations; and
- ✓ Job Shop (a mixture of the above).

EXISTING SUPPORTING TECHNOLOGY

The types of low-VOC coatings formulations available today can fundamentally be broken down into four types: waterborne, exempt solvent borne, high-solids, and 100% solids applications. Within these categories, several resin systems are available including acrylic, polyurethane, alkyd, nitrocellulose, and various copolymers or modifiers including but not limited to latex, polycarbonate, polyethylene, and urea. Many cure types are also available as one-component air-dried and pre-catalyzed, two-component post-catalyzed, thermally cured and light curable. The AQMD does not promote the use of one type of coating formulation or type over another. All of the systems below represent materials that comply with the future limits of Rule 1136, unless stated otherwise.

Waterborne

Waterborne coatings are available in several cure systems consisting of single-part non-catalyzed and pre-catalyzed (chemically reactive upon evaporation of the water), and post-catalyzed plural-component reactive coatings including moisture curable urethanes at zero VOC as well as waterborne ultraviolet (UV) curable coatings. Waterborne wood finishes are available and in use for every application step including stains, sealers, topcoats, toners and glazes, primers and undercoaters, as well as fillers.

The most common resin system in water is acrylic. A good waterborne acrylic will exhibit good to excellent clarity, good to excellent chemical resistance and a high degree of re-emulsifying capabilities when layered upon itself, or upon a coating compatible with an acrylic film. Due to wide variations in formulations, acrylic formulations will range in VOC content from zero to about 275 grams of VOC per liter of coating (less water) and this applies to clear and pigmented topcoats, sealers, primers and undercoaters both. Waterborne acrylic low-solids stains can have VOC contents below 20 grams per liter of material. Some coatings manufacturers have formulated hybrid waterborne systems consisting of blends of acrylic with latex, polyurethane, epoxy, polyethylene and/or polycarbonate. Coating expense increases with the addition of resin modifiers. Typical volume solids content of these coatings vary from about 8% for low-solids stains to approximately 28 to 60% for topcoats and 30 to 66% for pigmented undercoaters and primers. Most waterborne acrylic formulations contain glycol ethers in small percentages (ethylene or propylene). Such chemicals are associated with long term exposure health risks (chronic exposure).

The second most popular resin system in water is polyurethane. These systems range in VOC content from zero to about 200 grams per liter, less water and are relatively high in solids (approximately 50%). Waterborne polyurethanes are fully reacted urethane polymers dispersed in water. Urethanes contain isocyanates as condensation reaction agents, in small percentages, that are also toxic. Waterborne polyurethanes can be selected to deliver strength, chemical resistance, high elongation, UV resistance, low temperature flexibility, water resistance, abrasion resistance, and/or impact resistance. Waterborne polyurethanes are generally compatible with many other types of waterborne coatings such as acrylics and can be used as modifiers for blended resins which further enhance film properties.

Perhaps the largest impediments to successful waterborne coating use on wood is contamination of the surface through either airborne or substrate dusts, improper spray technique, and longer dry time needed prior to stacking the coated product. If the substrate is not clean (and maintained clean) dusts will telegraph through the finish. Edges can also overbuild with improper spray technique and look excessively plastic; so that several thin applications result in better appearance than heavier coats. For high production purposes, fast dry time is crucial to allow packaging and stacking. The solution employed by savvy manufacturers is to reduce the dry time with gas fired or infrared ovens and/or fans that act to accelerate the release of water out of the finish, although there are several plural component coatings on the market that will cure in 15-20 minutes and in humid environments, but are more expensive on a per gallon basis. Process modifications, such as the installation of protective corner pieces, will aid in distribution of the load away from the finished wood substrate when product stacking is necessary.

Exempt Solvent Borne

Acetone is the foundation of high-VOC (540 + grams VOC per liter, less acetone) nitrocellulose resin systems that are still in wide use today. The topcoats attained by these coating systems are easy to apply and redissolve each subsequent coat into the previous one. This forms a single high-build film that is clear, easily sanded, buffed and repaired. There is no question that these coatings afford a beautiful sheen and clarity that provides the basis for coating comparison, particularly on high-end furniture and musical instruments. Reduction to 275 grams VOC per liter, less exempt compounds on or before July 1, 2005, will likely mean the demise of acetone-based co-solvent single-component nitrocellulose topcoats, as well as most catalyzed nitrocellulose coatings, which offer the same appearance but with a harder film.

Some acetone-based wood products coatings are available in low-VOC and in a range of coating types including but not limited to stain, toner, and glaze, sanding sealer, and catalyzed topcoat. High-solids stains, toners and glazes have been developed (and being used) at concentrations below 210 grams VOC per liter of coating. Low-solids stains have also been created at less than 40 grams VOC per liter of material. These coatings may fill the slight void left open by waterborne stains, which can be problematic with respect to color matching. In addition, acetone-based catalyzed varnishes are also available in the 200 grams VOC per liter of coating range that are self-sealing. Dry times of acetone-based products can also be accelerated, if needed, with the addition of infrared light. Typical resin systems in use with acetone today are based on nitrocellulose (stains), vinyl (sealer), alkyd (stains) and modified alkyd (catalyzed topcoats), as well as various proprietary polymers.

The largest hurdle with high quantities of acetone in coatings is excessive evaporation. This can lead to a dry spray edge and coating blushing. Blushing is a haze caused by moisture condensation in the coating film due to excessive evaporative cooling. Acetone also poses a fire hazard due to its high flammability, so that potential users of acetone-based materials should check with their local fire department for any restrictions imposed therein.

High-Solids

When compared to 18% solids of old formulations, almost anything would be considered high-solids, however for the purposes of this section, only materials with at least 75% solids will be considered. The only true candidate at this level of solids is polyester. Polyester finishes are necessarily high build coating systems with excellent grain filling properties. They are available and in use as self-sealing systems in clear and pigmented formulas. One drawback, that they contain the monomer styrene as a viscosity reducer. Styrene is a hazardous air pollutant and a VOC. Typical VOC contents range from 180-250 grams VOC per liter. The odor of styrene is particularly pungent and many operators find the smell objectionable.

Thermally Cured

Within the last few years, powder coatings have been developed, largely for use on medium density fiberboard (MDF). Powders are near 100% dry solids materials (finely divided resins, curing agents, minerals and pigments) that are usually spray applied with the use of a downdraft or backdraft spray booth and reclaiming dust collection system. The effective transfer efficiency or utilization rate of powder coating is about 98% when reclamation techniques are used. Under the conditions of EPA Reference Test Method 24 (Determination of Volatile Matter Content, Density,

Volume Solids, and Weight Solids of Surface Coating), where samples are heated to 110 °C for an hour, a volatile weight loss of approximately 0.5 to 1.0 percent may be present and expressed as off-gas VOCs in the bake cycle.

When powder coating MDF parts using thermally cured powders, wood products are loaded onto an overhead conveyor system, flushed with compressed air (to minimize surface particulate contamination), and preheated before entering the powder coating booth. Preheating improves powder deposition on the low-conductivity substrate and minimizes the manifestation of moisture in the board that outgases and compromises finish quality. While the board surface is still warm, powder is applied electrostatically to the grounded wood substrate which is followed by convection or infrared heating that thermally flows and cures the deposited resins and pigments under low temperature (190 - 250°F). Parts exit the bake cycle and are allowed to cool to ambient temperature and are then ready for assembly or packaging.

In lieu of thermally cured powders, UV curable powders are available for applications that use the same process (i.e., cleaning, preheating, electrostatic application, and heating to flow temperature) but afterward the coating is exposed to ultra-violet light which crosslinks the softened powders in a matter of seconds; as opposed to several minutes with thermally cured powders. Powder coatings on wood are evolving as suitable replacements for thermofoil (high pressure bonded vinyl to MDF), and some high-pressure laminate applications. Powders are available in all finishes (smooth to textured), sheens (low to high gloss), and opacities.

Light Curable

Ultraviolet curable coatings, and transport and lighting configurations have been available for use for over 40 years and the technology is continually improving. Curing systems typically consist of a high voltage power supply, a control panel, UV curing lamp(s), a reflector system for focusing the UV energy, and a cooling system to maintain proper operating temperatures of the UV lamp(s).

The mainstream UV lamp is a mercury lamp. An inert gas, such as argon or xenon, together with a small amount of mercury, is used to fill the tube which has electrodes installed at the ends. When the lamp is connected to a power source, an electrical arc passes between the two electrodes, vaporizing the mercury. A large energy release occurs and results in an extremely bright, intense light that is primarily white light, infrared and ultraviolet light.

The second form of lamp is the electrodeless lamp. This type of lamp has a similar spectral emission to the electrode type but the method of operation is totally different. The lamp in operation is energized by microwaves that are generated by magnetrons rather than an electrical arc. The tube can be filled with other materials depending on the spectral emission required for the application. This type of light is more powerful because it operates at higher frequency than the arc or electrode type lamp.

Most UV curable wood coatings are based on acrylated epoxies, polyesters, and urethane oligomers, which are low to medium molecular weight resins. Monomers are added as reactive diluents (viscosity reducers) and free radical photoinitiators are blended in to set off chain reactions when exposed to UV light and cause polymerization. The remaining component is filler,

which consist of pigments, stabilizers and surfactants for instance. Cationic UV curable coatings are also available in epoxy based oligomers. Hybrids of various oligomers are now available that enhance final film properties (urethane-acrylic for example).

UV curable coatings are no longer just 100% solids. Waterborne, acetone, and even VOC based UV curable coatings are available to achieve thinner film deposition, reduce toxic monomer content, provide a mechanism to formulate matte finishes (greater shrinkage), and speed up the cure rates of non-UV activated waterborne and solventborne materials. All application types are available from flow coating, roller coater, and sprayable UV coatings in various glosses, and can be formulated in stains and other semitransparent materials, and technology exists to cure pigmented coatings. UV applications are typically conducted on automated lines so that exposure to skin irritants and powerful light sources are minimized to the worker.

Most UV cure processes in application today are for flat-line products (products that are predominantly two-dimensional). However, equipment manufacturers can engineer UV curing equipment to cure three dimensional objects such as fully assembled furniture; but the cost of the curing equipment goes up with each added energy source. UV coating on wood substrates is a viable option to regulatory compliance and coating performance for a wide variety of products. Normally, the advantages associated with the application of UV materials are: higher chemical resistance, increased impact and abrasion resistance, lower energy consumption and small equipment footprint compared to standard bake cycle ovens, increased production rates through rapid curing, elimination of flammability concerns, and the potential for zero-VOC emissions. More information is obtainable from Radtech, the leading association for companies manufacturing UV curable coatings and curing equipment, and for companies using the technology.

Very few companies within the South Coast Air Basin use UV curable coatings on wood substrates. Perhaps because many high production companies have already updated their coating lines to accommodate waterborne coatings by installing infrared or convection ovens and stainless steel plumbing and spray equipment, or by installing air pollution control equipment in the case of high-VOC nitrocellulose lacquers, and are therefore satisfied with their current practices.

TBAc

Tertiary butyl acetate (TBAc) has recently been petitioned to be delisted as a VOC by the US EPA based on its low reactivity to form ozone in the presence of oxides of nitrogen and a light source. To date, the compound is not yet approved as an exempt compound. If, in the near future the EPA and AQMD delists TBAc, nitrocellulose wood topcoats may be able to be formulated as low-solids, low-VOC topcoats. Without TBAc, these coatings will likely be a phased out in the South Coast Air Basin due to excessive VOC content. Nitrocellulose wood coatings have been formulated with TBAc, as it is a good viscosity reducer, displays an evaporation rate in the same range as methyl ethyl ketone and toluene (good for blush resistance), and it has a flash point much higher than acetone so that fire hazard is reduced (60 °F compared to -10 °F). At this time, TBAc is not a listed HAP or an AQMD Rule 1401 compound, however, it may potentially metabolize to tert-butanol in the body, which is a toxic compound.

INDUSTRY EXAMPLES

Staff has visited facilities within the boundaries of its jurisdiction in an effort to obtain relative data concerning process and coatings applicability as it currently exists in the local region. The following examples reflect the technology in use during inspections conducted from November 2002 through January 2003.

EXAMPLES OF INDUSTRIES SUCCESSFULLY CONVERTING TO LOW-VOC FINISHES

Southcoast Cabinet Inc.

Southcoast Cabinet is a manufacturer and installer of kitchen and bath cabinetry for the new home construction industry and is located in Walnut, CA. They use melamine-covered MDF board as interior components fabricated to form the box. Sides and tops that show are typically cut from veneered hardwood that is laminated to plywood. Face frames and doors are made from solid wood components. All coated surfaces are meticulously sanded to provide a smooth surface for the application of waterborne low-solids stains, sealers, washcoats, and primarily clear topcoats (some pigmented waterborne topcoats are applied). All types of wood are used and include alder, ash, birch, cherry, maple, mahogany oak, pine and walnut.

Southcoast uses Sherwin Williams products consisting of water reducible low-solids wiping stains and dyes of various colors, acrylic/latex sanding sealer and clear topcoat, as well as a waterborne-modified polyurethane for pigmented topcoats. Their line is conveyorized, and uses multiple spray booths in connection with spray applied and hand wiped stains and washcoats. After each coating step, natural gas-fired ovens are used to drive the water out. Slight sanding is necessary to rub out minimal grain raise. Two coats of waterborne lacquer are used and the finish is clear, hard and glossy. All coatings used meet or are below the July 1, 2005 VOC limits, and meet the Kitchen Cabinet Manufacturers Association (KCMA) specifications.

Proskate

Proskate, located in Anaheim, is a manufacturer of 5-ply laminated skateboards. The boards are assembled and formed under high pressure. Templates are used to cut off excess material and are further processed with routers and sanders. The company uses either three coats of waterborne acrylic sanding sealer as a finished look or will seal and topcoat with a waterborne acrylic pigmented coating. A thermally applied decal is adhered to most boards on top of the cured coating at a temperature of approximately 200 degrees Fahrenheit. SDA/Craft Technologies, a local independent wood coatings formulator that specializes in manufacturing a fully compliant line of dye stains, sealers, primers, and pigmented and clear topcoat waterborne systems is their current vendor.

Acme Billiards

Acme Billiards of Los Angeles is a small manufacturer of pool tables and other high end table top games specializing in custom fabrication only. They use solid woods consisting mainly of cherry, maple, oak and poplar. Acme uses less than 10 gallons of wood products coatings per month, well within the exemption for less than a gallon per day, and could use high-VOC products of any kind on this basis. However, the owner is pleased with the lack of strong odors in his shop and is

ultimately satisfied with the finish of his waterborne acrylic dye stains, sealers and pre-catalyzed clear topcoats he obtains from SDA/Craft Technologies.

Blackhawk Furniture

Blackhawk Furniture of Riverside, CA is a manufacturer of oak home furniture. The facility uses a conveyor line in association with all applied stains, sealers, and clear topcoats. Infrared (IR) ovens are used to flash proprietary polymer acetone-based high-solids stain and nitrocellulose acetone-based sealer when the weather gets cool or humidity rises. The clear topcoat is a single-component waterborne acrylic flat finish that is force dried by ambient air fans and IR light sources. The coatings are all manufactured by Alternative Materials Technology (AMT), Inc. Blackhawk is a high volume manufacturer and have optimized their production through close work with AMT staff. The topcoat, stain and sealer are below 175 grams of VOC per liter of coating and as such meet all future VOC requirements.

Lloyd's Custom Finishing

Lloyd's Custom Finishing is a job shop coating contractor located in Santa Fe Springs, CA. Lloyd's uses mostly pigmented primers, undercoats and topcoats to finish solid and various wood windows, doors, molding, and shutters. The process uses simple air dry and light sanding to obtain a finish that is smooth, hard and durable. On colder days, a small portable IR heater is directed at the wooden parts to accelerate cure time. The coatings manufacturer is Aqua Coatings which makes only fully compliant waterborne acrylic and modified acrylic coatings ranging from sanding sealers, clear topcoats, low-solids stains, to pigmented primers and topcoats.

Cabinets 2000

Cabinets 2000 is also a manufacturer of kitchen and bath cabinetry for new home installation located in Norwalk, CA. Cabinets 2000 uses a frameless construction (no face frame) and builds its boxes with melamine covered MDF board. In addition to coating, they operate a thermofoil application system. The company is primarily using Valspar alkyd resin based stains in acetone. The topcoat is a two-part catalyzed alkyd-urea conversion varnish in low-luster (30-sheen). When sealers are used, a vinyl-modified system in acetone is employed. Glazes are used for highlighting solid white topcoats but remain high in VOC (445 gm VOC/l). However, the conversion varnish meets the future VOC limit for topcoats, and the stains are well under the 120 grams per liter of material requirement as of July 1, 2005. The company is not fully compliant with all future VOC limits at this time due to the use of the solventborne glaze and marginally higher VOC sealer (300 gm VOC/l, less acetone). KCMA specs are fully attained. In addition, Cabinets 2000 has future plans to install a UV coating line.

Penny Lane

Although technically exempt from VOC regulation because of small usage, Penny Lane Furniture Refinishing is a small owner-operated refinishing shop in Los Angeles that has been using waterborne sealers and topcoats that meet the 2005 limits on a variety of wood substrates for ten years. They do use universal tint colors (UTCs) on occasion that exceed the low-solids stain limit upon application due to high thinning with mineral spirits.

All pieces are fully sanded of old finish, sealed and topcoated with acrylic finishes by Paramount Coatings. In the opinion of the author, the resulting appearance was the best that we had seen with water. Comparing a headboard that had been finished with nitrocellulose lacquer by a refinisher outside the basin, with several coats, the resulting waterborne finish was 90 to 95% of that of nitrocellulose. The only difference was a slightly softer feel between the two in favor of nitrocellulose. The gloss and clarity were every bit as good as the nitrocellulose coated headboard, and the finish was hard as rock. Most finishes are rubbed out with steel wool and wax to reduce the gloss of the waterborne finish to a satin finish, which also looks beautiful.

EXAMPLES OF COMPANIES THAT HAVE FOUND THE TRANSITION TO LOW-VOC DIFFICULT

Cardinal Church Furniture

Cardinal Church Furniture is the last remaining church pew manufacturer in the South Coast Air Basin. They are currently using acetone-based catalyzed clear lacquers, pigmented undercoat, sealer, and stains. All of the materials comply with the current limits at just slightly below 550 grams VOC per liter, less exempt solvent, and the resulting emissions are approximately 3 tons of VOCs per year. With nitrocellulose coatings, pew parts can be coated, stacked, and delivered in 24 hours if the need arises. After having tried waterborne coatings in the past, the owner is highly skeptical about the performance of them due to several jobs that failed. The coatings never cured or would soften in high humidity or under body heat and ultimately transfer to the clothing of church goers. He cites denim as being very abrasive and other fabrics as problematic to the applied coating as he needs a 20 year lifetime scuff resistance to be competitive in this marketplace.

Only 30% of Cardinal's business is new construction. The remaining business is refinishing. Old church furniture is disassembled, brought back to the Irwindale facility, sanded to near bare wood, refinished, stacked and reassembled at the job site within a few days. The owner claims that waterborne coatings do not adhere to old nitrocellulose based coatings, and that dry time is insufficient to stack pew parts without sticking, which is required in his accelerated finishing operation. The owner also claims that color matching existing church finishes is all but impossible with waterborne stains, because of the lack of sufficient penetration into the wood. Staff has reviewed current technology with the shop owner, and has encouraged him to test the latest waterborne coating systems and existing super compliant acetone-based sealers and high solids stains. Staff is committed to working with Cardinal Church Furniture in an effort to address his concerns.

Rickenbacker Guitars

Rickenbacker of Santa Ana holds the distinction of inventing the electric guitar. They turn out 25 guitars per day of both the electric and acoustic type, as well as electric bass guitars from solid wood and in-house manufactured electronics. Each guitar takes approximately 15 days to complete. Among the types of wood used are alder, maple, and walnut for construction of the body and neck. Bubinga wood forms the fingerboard. The guitars are said to be one-piece construction as all the components are interlocking and joined together with adhesive.

Since converting from nitrocellulose lacquers in the early 1970's, Rickenbacker has used high-VOC stains and two-component "conversion varnishes", in successively thin coats to produce its

characteristic high-gloss finished guitars (85 to 98 percent reflectivity). As many as eleven independent coating layers are spray applied and air-dried with sanding steps in between. The final gloss is achieved by using polishing compounds. The finish of the guitar must withstand extreme temperature differences as their guitars are sold around the world and shipped to various concert sites by jetliner. In addition, the finish must withstand various hand emollients, perspiration, and contact with nitrile rubber from neck straps and soft chlorinated plastics (guitar stand cushions) without deleterious effect. Since guitars are lifetime investments for many musicians, Rickenbacker maintains its reputation by providing the best coating and coating process that will result in lifetime performance and beauty.

The company has a policy to test any and all new coating technologies. Single and dual-component waterborne coatings as well as UV curable have all been tried but have yet to meet its testing standards for coating checking. Coatings applied over thin wood are especially vulnerable to "sinking" of the material into the pores of the wood over time, which causes coating fractures or checking as the material continually shrinks. Rickenbacker claims that this is due to incomplete crosslinking of the coating molecules (even with UV curables). Two other guitar makers (one in Ventura County and the other in San Diego County) have overcome the problem by using dual-cure sealers (catalyst cured and solvent borne UV cured); however, they continue to use high-VOC stains and washcoats. At this time Rickenbacker is continuing to try waterborne samples from SPI Incorporated that is described as *nearly* perfect. However, staff is unaware of any guitar manufacturer that is 100 percent compliant with the future VOC limits of Rule 1136.

Fender Guitar

Fender Guitar of Corona makes the most widely played guitars in the world. They are a large company and manufacture 220 to 300 guitars a day including acoustic and electric guitars as well as acoustic and electric bass guitars for shipment around the globe. Rather than change their process they prefer to use control equipment to capture and abate the emissions stream. They currently use a regenerative thermal oxidizer (RTO) to comply with Rule 1136. The capture system qualifies as a permanent total enclosure, therefore fugitive VOC emissions are said to be 100 percent capture efficient.

The types of coatings used at the Corona Facility are not compliant with the future VOC limits. A high-solids compliant polyester coating is applied in Mexico as a sealer and grain filler from which successive coats of solvent borne nitrocellulose lacquers or polyurethane are added as topcoats in Corona, CA. A waterborne sealer is applied to the neck, but it exceeds the 275 grams VOC per liter of coating limit of July 1, 2005. Notwithstanding the use of add-on control equipment to comply with Rule 1136, staff is unaware of any high-end stringed instrument manufacturer that is fully compliant with the July 1, 2005 VOC limits of Rule 1136 by direct VOC concentration.

PROGRESS REPORTS

The AQMD sent out notification of progress reporting requirements with an accompanying fill-in-the-blank form to 1,061 companies. An additional 21 companies reported without receiving a notification letter. This results in a total number of facilities in the data pool of 1,082. The names and addresses of notified facilities were identified by using the District's Clean Air Support

System (CLASS) and the Permit Administration Application Tracking System (PAATS). Out of this total 235 were returned as undeliverable by the U.S. Post Office (Out of Business), 67 reported no Rule 1136 coating activities at the facility, and 366 companies submitted meaningful data (46.92% of the universe of wood finishers). Tables 1 and 2, and Figures 1 and 2 below offer the latest information available as of April 22, 2003.

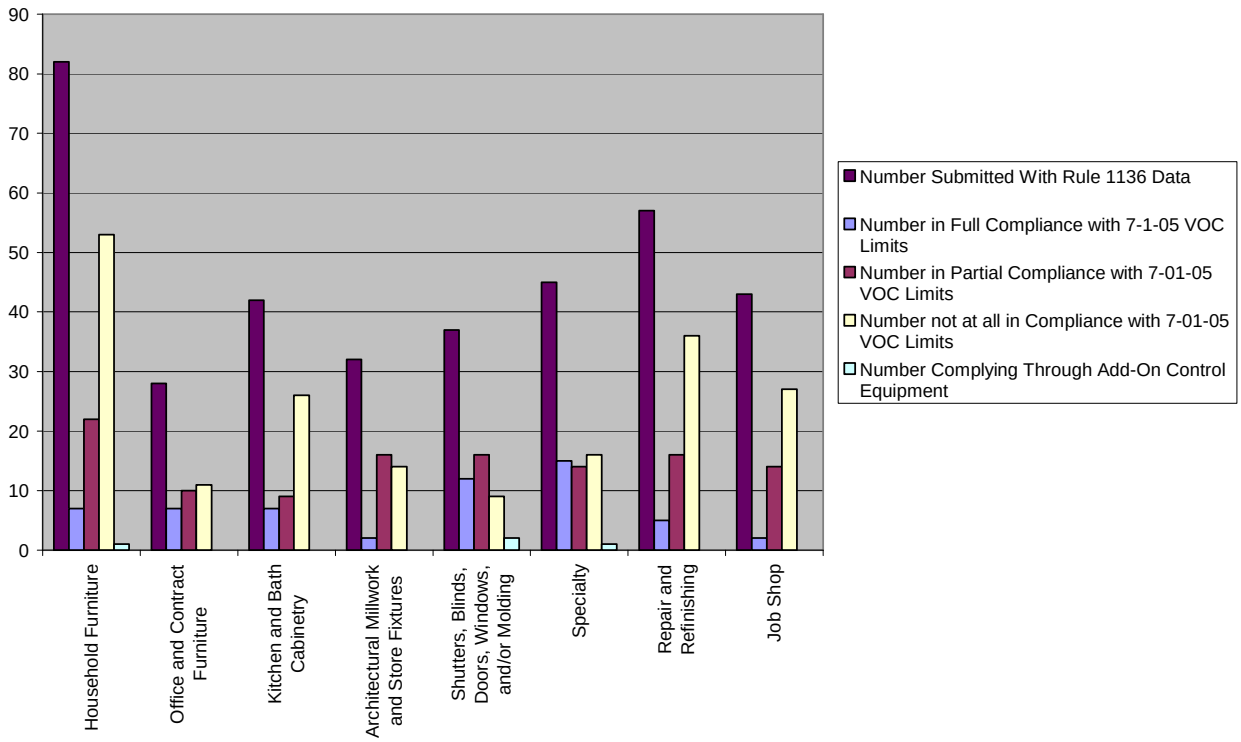
Table 1
Summary of Initial and Final Progress Report Submittals

Total Initial Mailings and Voluntarily Submitted Progress Reports	Total Returned as Undeliverable or Out of Business	Total Responding as not Finishing Wood Products	Universe of Rule 1136 Facilities	Total Responding as Wood Finishers	Percentage of Submitted Progress Reports the Universe of Rule 1136 Facilities
1082	235	67	780	366	46.92%

Furthermore, each of the companies that completed a progress report are grouped below by industry type and whether they are in full compliance, partial compliance (at least one coating meeting the final VOC limits of July 1, 2005), or not meeting the future VOC limits at all. Figure 1 gives this information.

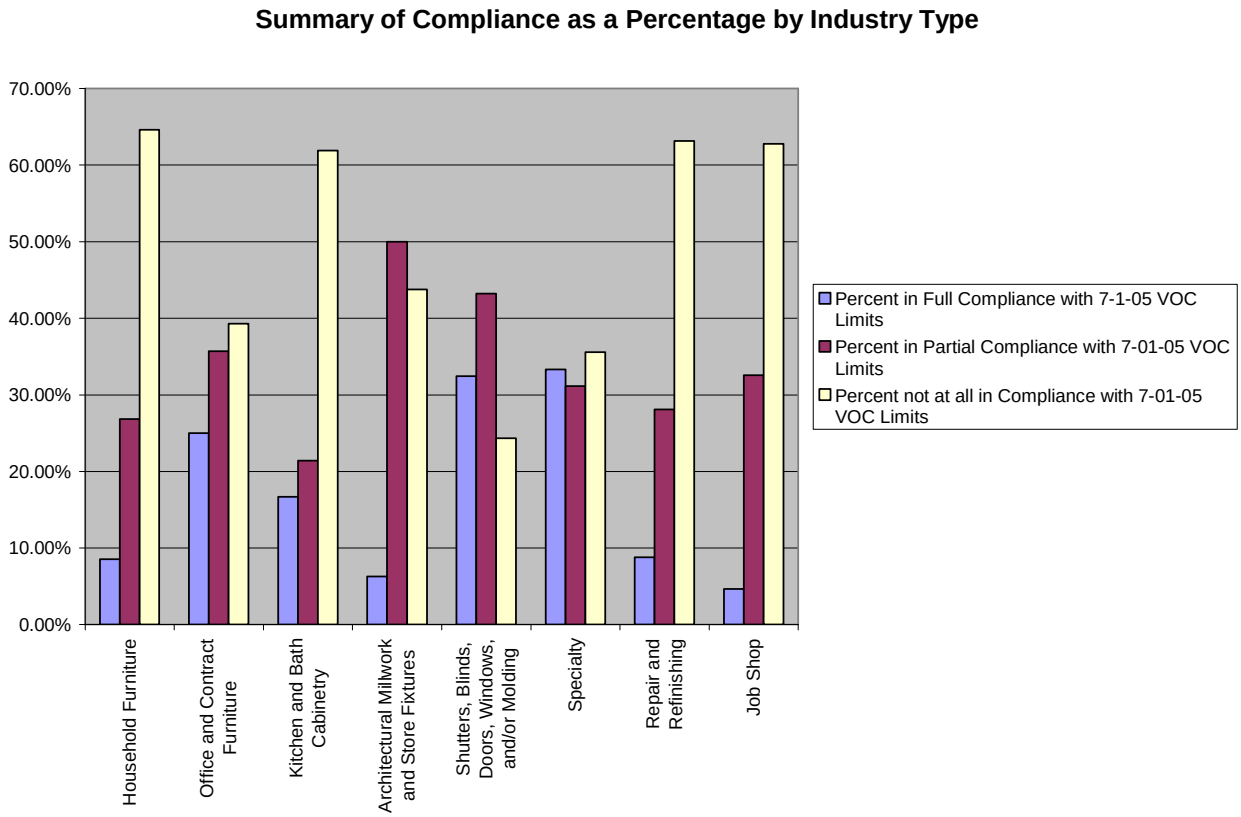
Figure 1

Summary of Compliance with the July 1, 2005 VOC Limits by Industry Type



The compliance statistics expressed as a percentage of the total submittals, by industry category, are shown in Figure 2.

Figure 2



Finally, Table 2 shows the summary of the compliance status for all Rule 1136 facilities that submitted a progress report.

Table 2
Summary of Compliance of All Rule 1136 Reporting Facilities

Facilities in Full Compliance with 7-1-2005 VOC Limits	Facilities in Partial Compliance with 7-1-2005 VOC Limits	Facilities not Meeting any 7-1-2005 VOC Limits
15.57%	31.97%	52.46%

DISCUSSION

Although the wood coating industry have available to it wood products coatings that will work (as demonstrated in most categories, except guitar manufacturing), only 15.6 percent of the companies that submitted progress reports comply with the full provisions of the final VOC limits of July 1, 2005. Four (1.0%) qualify by equivalent compliance with add-on control equipment. However, 32.0 percent partially comply with the final VOC limits by using at least one product that meets the future VOC limits. Still, a full 52.5 percent of the returned progress reports indicate no

compliance with the July 1, 2005 VOC limits. Although the data is not fully represented by all wood finishing facilities, staff believes the data is representative of the whole because of the hundreds of data points included in the analysis.

CONCLUSIONS AND RECOMENDATIONS

Adequately performing wood finishes that meet the July 1, 2005 VOC limits are available and have been successfully used across the spectrum of wood finishing operations including, household, office and contract furniture, cabinets, millwork and store fixtures, shutters, doors and windows, specialty wood products as wells as repair and refinishing operations, as indicated in staff's technology assessment. The expressed future VOC limits provided by Rule 1136 are established low enough to provide for a broad range of resin systems and cure types that will afford the industry sufficient choice in waterborne, exempt solvent borne, and high-solids coatings while dramatically reducing smog forming compounds. Staff believes that technology exists, even for guitar manufacturing that can be utilized within the maximum future limits of Rule 1136, considering there are two more years to go before the final limits take effect.

Successful conversion to waterborne coating systems necessitate a willingness to change, proper training of spray coating personnel, may require additional sanding steps and added heat acceleration, substantially cleaner work surfaces, and good technical support from coating manufacturers.

APPENDIX

Staff conducted a consultation meeting on June 10, 2003 in an effort to solicit public comments on the content of this document. The following represents the comments received on that day. Responses to these comments are included and are as follows:

Comments and Responses

Comment No. 1
We manufacture and recoat church furniture. It has become increasingly more difficult to compete in this business when my competition is able to use coatings that I cannot. Our products need a durability of twenty years due to constant human contact. Nitrocellulose coatings provide that durability for us and allow fast turn around. We tried water based coatings when this rule was adopted and 20 out of 25 jobs had to be refinished due to coating softening and sticking upon stacking. It cost us thousands of dollars to repair the damage caused by the use of waterborne material.

Response
Staff has identified a number of compliant coating systems other than waterborne, including blends of synthetic resins, light curable products, thermally curable coatings, high-solids polyester materials, and exempt solvent borne coatings that will meet the future VOC limits of July 1, 2005 and have been demonstrated in practice to work.. In addition, there is a new generation of waterborne formulations that has developed over the last several years tha is far superior in performance to previous materials and these products may have overcome the difficulties previously experienced.

Comment No. 2
We currently use acetone-based products that meet the future limits and have also spent thousands of dollars replacing waterborne failures as far back as 1985. My concern relates to the growth of my business and a facility cap on emissions that decreases every time I make a change in equipment, be it a modification to a spray booth or the addition of a heater. I have been denied permit changes, and have suffered emission reductions on the basis of best available control technology restrictions. Although my business is growing, I cannot move without losing valuable emission limits.

Response
This issue is the expansion of the operation resulting in an increase in emissions over current levels and compliance with the requirements of Rule 1136. An expansion project for this facility could be handled no differently than any other stationary source that increases emissions. The new or modified equipment would have to be constructed using Best Available Control Technology. The emissions increase must be mitigated and it must be shown that the construction will not cause or contribute to the exceedance of an ambient air quality standard. These requirements are in addition to the source specific rule requirements such as those for Rule 1136 and compliance would be demonstrated through the AQMD permitting process.

Comment No. 3
See the response to Comment No. 1. There have been improvements in waterborne technology in the last several years. In addition, there are a number of other compliant coating options that do not involve waterborne systems.

Response
The newest waterborne coatings are said to dry to sand within 30 minutes (and some within 15 minutes) of initial application. Stain matching with the latest waterborne dye stains is made easier that in previous years. If there were just to may problems with it, then we would not see any conversions, which is not the case.

Comment No. 4
What is the size distribution profile of companies that submitted progress reports? Within that distribution, what is the difference between large and small users, and what is done at a larger shop? Small shops cannot take the risk to switch to low-VOC without failure because they have little cash reserves. I would like to see socio-economic assessment conducted. There should be a BACT and reformulation equivalency.

Response
Size distribution was not part of the questionnaire data. The progress report questions only reflected responses to categorization of business type, coating process, types of wood coated, VOC contents of finishes used, and questions related to what types of coatings the facility has tried in the past (and its performance), what coatings it will try in the future, any process modifications expected when future limit coatings are tried, if add-on control will be used, and if Mobile Source Reduction Credits (MSRCs) or other alternative emission reduction techniques would be implemented.

Staff disagrees with the generalization that small shops cannot bear any liability for the quality of the finish. Through staff's field evaluations, staff identified small operations, including two shops (Acme Billiards and Penny Lane) discussed in the report that are very small operations that have made the switch to low-VOC coatings with great success. Staff believes that the current rule, which stand in tact, which includes an exemption for one gallon per day facilities, is equitable and the VOV limits are achievable for both small and large operations.

A socioeconomic analysis was included as part of the supporting documentation and approved by the Board when the Rule 1136 was amended on June 14, 1996. Furthermore, the rule allows compliance through low VOC formulations and enhanced transfer efficiency, or the use of add-on air pollution control equipment. Several companies have elected to use the add-on control equipment option.

Comment No. 5
With the increase in population of California the burden of air pollution reduction should be directed to automotive sources since they contribute 80% of the problem. My company has tried all waterborne formulations with limited success. Small coatings manufacturers simply cannot handle the volume required by this industry. Our competition is from the overseas market where regulation is nonexistent.

Response
The SCAQMD, as an extreme ozone non-attainment area in the country, has the obligation to pursue the most stringent control achievable for stationary sources and aggressively pursue controls of mobile and area sources. AQMD rule include several that apply to mobile and area sources.

There are a number of other coating options to compliance that do not incorporate just waterborne finishing solutions. See Response to Comment No. 1.